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SEISMIC DATA LABORATORY
QUARTERLY TECHNICAL SUMMARY REPORT

JULY - SEPTEMBER 1970

15 OCTOBER 1970

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Washington, D. C.

By
SEISMIC DATA LABORATORY

Under
Project VELA UNIFORM

Sponsored By *[Signature]*

ADVANCED RESEARCH PROJECTS AGENCY
Nuclear Monitoring Research Office
ARPA Order No. 624

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SEISMIC DATA LABORATORY
QUARTERLY TECHNICAL SUMMARY REPORT

July - September 1970

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P. O. Box 334, Alexandria, Virginia

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ABSTRACT

This report summarizes the work done by the SDL during the period July through September 1970, and is primarily concerned with seismic research activities related to the detection and identification of nuclear explosions and earthquakes. Also discussed are the support tasks and data services performed for other government contractors and for participants in the VELA-Uniform and PRIME ARGUS projects.

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I. INTRODUCTION

This quarterly report summarizes the technical work, support effort, and service tasks completed during the period July through September 1970. Current and past work are mentioned only if related to the present discussions.

Reviews of technical reports completed during the reporting period are contained in Section II under descriptive headings. Section III is a summary of the support and service tasks performed for other government contractors and for VELA-Uniform and PRIME ARGUS participants.

II. WORK COMPLETED

A. Analysis of Long Period Seismic Signals and Noise Recorded at LASA, TFO and UBO

Long period signals recorded at the seismic arrays UBO, TFO and LASA were analyzed in this investigation to determine the fundamental mode Rayleigh wave dispersion curves for paths from different source areas to each of the arrays. These paths are mixed continental and oceanic, and the dispersion curves calculated fall within the range between the average dispersion for a pure continental path and that for a pure oceanic path; an example is shown in Figure 1. Analysis of the long period noise (15 to 50 seconds) recorded at each array also shows the rms value to be in the 8 to 20 μ range. Moreover, simple beamforming gives approximately N^2 db reduction in noise at all arrays. Finally, the results of this study show that using a group velocity of 3.5 km/sec results in signal loss for some events in the LASA beams.

B. Relative Location of Explosions Using Surface Waves

This analysis describes the development and testing of a method of relative location for explosions using Rayleigh waves. The technique involves cross correlating a wavetrain with a previously recorded signal from the same source region and determining a relative "travel-time" from the peak in the cross correlation trace. Results of the study indicate that locations are fairly accurate, but that they do not compare with the precision locations obtained with body waves and relative travel-time corrections. A number of causes of errors are discussed, and it is estimated that a sophisticated application of this method would yield location comparable to relative travel-time locations for large events.

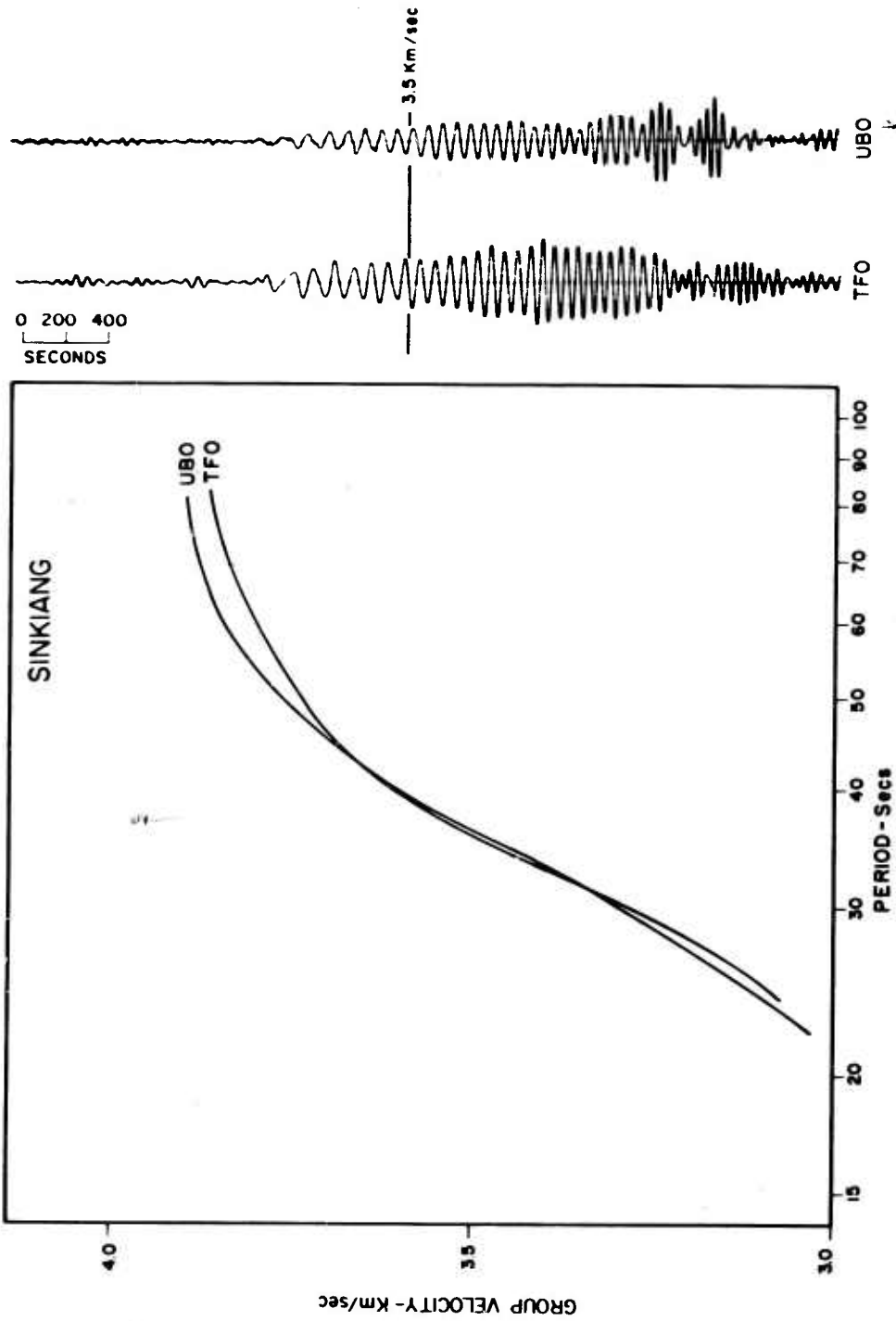


Figure 1. Dispersion of fundamental mode Rayleigh waves from an event in Sinkiang.

C. Analysis of Seismic Events as Recorded on Both Wide Band Long Period and Standard VELA Long Period Seismograph Systems

Since 25 September 1969, two wide band long period vertical seismograph systems (LZX and LZY) have been operating at TFO. These systems have an amplitude response peaked at approximately 40 seconds and have a wider pass band than the standard long period LRSM or VELA instruments. The wide band response is achieved with a Geotech 7505A vertical seismometer coupled to a photo tube amplifier with a six second notch filter and a galvanometer. The free period of the seismometer is 26 seconds and that of the galvanometer is 108 seconds. The response of these wide band systems is very similar to a long period broad-band seismograph system developed at Lamont Geological Observatory (Pomeroy et al, 1969; and Molnar et al, 1969). The two wide band seismograph systems at TFO are located at the same site as a standard VELA vertical seismometer (LZ1).

Seismic events recorded by this standard seismograph system and the wide band (LZX) system were analyzed in this study to compare the performance of the two recording systems and to see if the wide band systems could detect more long period energy than the standard systems.

The results of the analysis revealed that these systems yield equivalent information concerning long period energy in the signals as shown in Figure 2. The study further showed that Rayleigh wave energy at periods greater than sixty seconds was determined to originate almost entirely from events with epicenters near oceanic trenches or oceanic ridges.

III. SUPPORT AND SERVICE TASKS

In addition to the research described above, the SDL performed the following tasks:

A. Data Cataloging, Classifying, and Retrieval

The library contains digitized seismograms, digital and analog magnetic tapes, 16 and 35 mm film data. Station logs corresponding to each data set are arranged chronologically either in loose-leaf binders or in file cabinets.

At the end of the third quarter of 1970 the library contains approximately:

16,302 digitized seismograms;
4,655 digital magnetic tapes;
29,388 analog magnetic tapes;

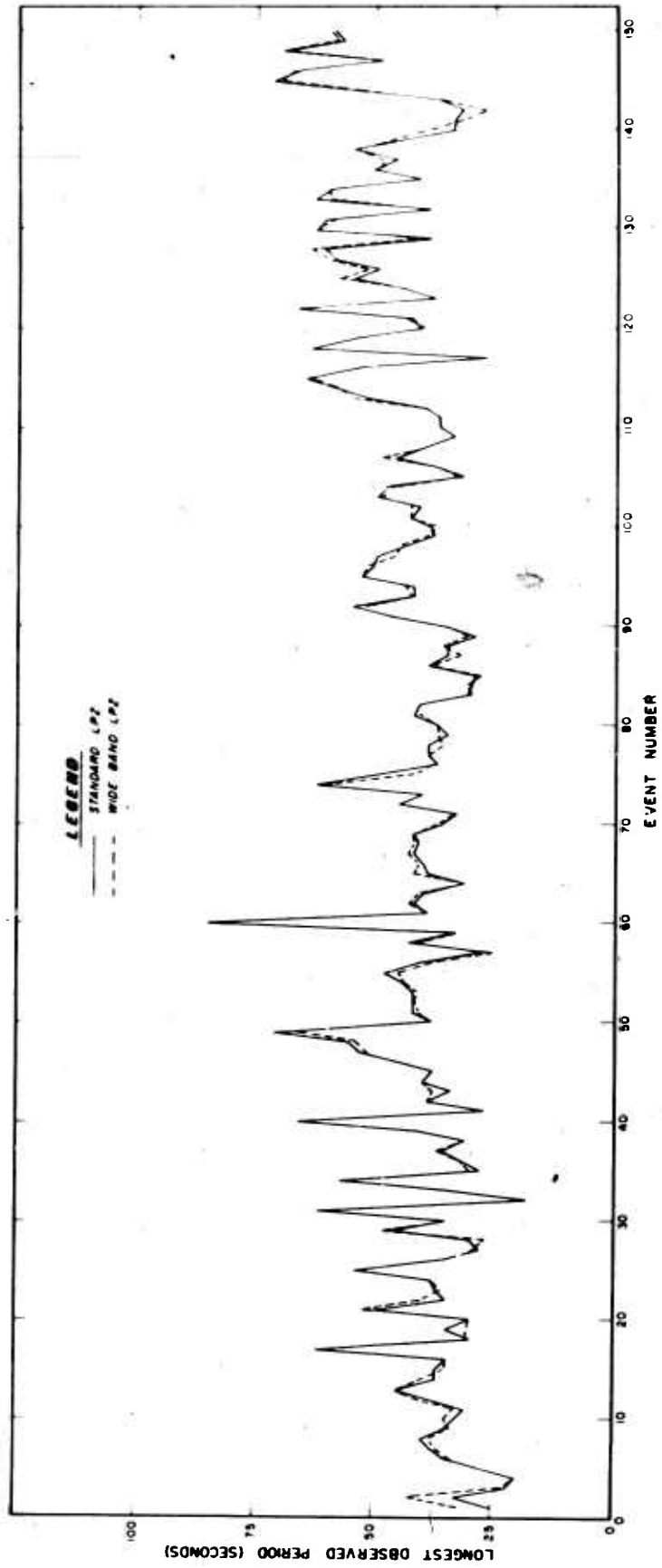


Figure 2. Longest observed periods in Rayleigh wave signals recorded by wide band and standard Vela long period seismograph systems.

as well as 16 mm film data recorded at seismic observatories during the period September 1960 to the present, and 35 mm film data recorded at LRSM stations during the interval September 1961 to the present.

Although the proportion of digital tapes assigned to a specific function changes constantly, the library consisted of the following groups at the end of the reporting period:

279	UBO multiplexed;
39	UBO demultiplexed;
1,670	LASA multiplexed;
582	LASA demultiplexed;
562	TFO-37 multiplexed;
84	TFO-37 demultiplexed;
98	TFO-37 permanent data;
1,341	Scratch, save and A/D.

The analog magnetic tape library consisted of the following groups at the end of September:

8,752	compressed;
2,013	uncompressed (6 months intentional backlog);
486	composites;
17,861	save;
0	shipped;
276	received.

B. Equipment Modifications

No equipment modifications were made during the third quarter of 1970.

C. Maintain and Operate Equipment

Equipment maintenance engineers were on duty two full shifts each day and were on standby for the remaining shift. During the reporting period their tasks included preventive and corrective maintenance.

Preventive maintenance was performed daily on all equipment in accordance with equipment maintenance manuals. The digital system received three additional performance checks on a monthly basis.

Corrective maintenance was performed on all major units during the reporting period. We continued to lease a model 763 plotter during the third quarter to replace our model 763 which is being repaired.

D. Digital Programming

Flow charts and descriptions of programs completed during the quarter have been delivered to the authorized government representative.

E. VELA and PRIME ARGUS Data Copies

During the period 01 July 1970 through September 1970, the SDL supplied data services to the following:

IBM
Lawrence Radiation Laboratory
Phoenix College
MIT, Lincoln Laboratory
Teledyne Geotech
U.S. Geological Survey
California Institute of Technology
Stanford University
Pennsylvania State University
Department of the Navy

F. Analog Tape Compression

During the third quarter of 1970 we compressed 950 field tapes. We shipped 1400 tapes to the Dallas facility, and 85 tapes to Minot Air Force Base, North Dakota.

G. LASA Data Service

The LASA weekly event summary has been modified to include events reported by Lincoln Laboratory which were not detected by the SAAC.

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<p>This report summarizes the work done by the SDL during the period July - September 1970 and is primarily concerned with seismic research activities related to the detection and identification of nuclear explosions and earthquake phenomena. Also discussed are the support tasks and data services performed for other government contractors and participants in the VELA-Uniform and PRIME ARGUS projects.</p>			
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